GPSPCI

USER MANUAL

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See important *limited warranty* information starting on page 9.

ADVISORY NOTICE

CONCERNING GPS SATELLITE SYSTEM

Depending on many factors beyond the control of Masterclock, the signals that are received from the GPS Satellites **are subject to interference, fading, satellite failure and other influences** *that could cause* the GPSPCI to generate erroneous time and/or date information.

It is the responsibility of the user to determine the adequacy and suitability of this device for the intended use.

INTRODUCTION

The GPSPCI is a PCI card that provides very stable accurate time and date information for a Windows PC. The card receives reference time information from Atomic Clocks in the GPS (Global Positioning System) satellites.

GPS SATELLITES
The GPS satellites are operated and maintained by the US Department of Defense and allow for the precise determination of local time and location at any point on (or above) the Earth. This is accomplished via the transmission of very accurate timing information from a series of satellites that provide coverage of the entire planet.

The GPSPCI extracts timing reference from these signals and generates time information to the PC that is synchronized to within less than 10 microseconds of UTC (Universal Coordinated or Greenwich Mean Time).

UTC/GREENWICH MEAN TIME
UTC is the local time at the prime reference meridian at Greenwich, England. At a given location on the planet, local time can be displaced (referenced to UTC) by -11 to +12 hours. North and South America are from -3 to -11 hours delayed; most of Europe and Africa and all of Asia and Australia are advanced by +1 to +12 hours.

TIME ZONES & DAYLIGHT SAVING TIME
The GPSPCI provides UTC to the PC's operating system. Time zone offsets and daylight savings time are handled as a standard feature of the operating system.

INITIAL OPERATION

Each GPSPC is thoroughly tested with its external antenna prior to shipment. Physical installation is simply a matter of installing the card into a PCI or ISA bus slot and connecting the antenna.

OPERATING THE GPSPCI FOR THE FIRST TIME
When the GPSPCI is initially powered up, after having been shipped to a new location, the time to first fix (time the unit takes to acquire satellites and extract correct time) could be up to 25 minutes although it is typically 5 - 15 minutes. Factors such as atmospheric conditions, antenna type, antenna location, and antenna cable length will affect the time to first fix.

The GPSPCI will provide time from an internal on-board clock whenever GPS time is not available. The onboard clock runs from a backup battery in the absence of power from the PC.

The GPSPCI's GPS navigation module has its own backup battery that maintains startup data when the PC is powered down. If, when starting up, the location, time and number of satellites that the GPSPCI can receive has not changed significantly since last power down, then the GPSPCI time will be available much faster.

ANTENNA LOCATION

Depending on the type of building where the GPSPCI is located and obstructions that may block reception of signals from the GPS satellites, the antenna may have to be located where it has an unobstructed view of the sky. In some cases, this can be accomplished by placing the antenna next to a window. However, usually it will require mounting it outside of the building or on a roof. In the worst case, the basic requirement for assured system operation is that the antenna module has a clear and unobstructed view of the sky for initial satellite acquisition and lock (generation of time information by the GPSPCI). It is possible that the system will operate indoors and under other obstructions. However this can only be determined empirically; it is not guaranteed.

If a longer cable is required, cables of various lengths (up to 500 feet) with pre-amplified antennas are available from Masterclock. **Bringing the GPSPCI up for the first time with an indoor antenna may prevent or significantly increase the time to first fix.**

INITIAL OPERATIONS AND I/O CONNECTIONS

1. Locate the antenna in a suitable area so that the top of the antenna module has a clear view of the sky. Do not move it until after the GPSPCI has initiated operation (explained below).

2. Connect the antenna coax to the SMA connector on the PC card bracket.

3. The unit first calculates coordinates and distances for acquisition of GPS satellites. The LED will remain off until satellites are acquired and precise location and timing references are established.

NORMAL OPERATION

After acquisition of satellites the GPSPCI will begin generating time information and the card LED will flash once per second.

FREEWHEELING

During continuous operation it is likely that the GPSPCI will experience occasional outages and loss of satellite reference time. This can be caused by atmospheric and many other outside conditions which are essentially unavoidable with a simplex system. Such signal losses can last from a few minutes to hours. When the condition disappears and the unit re-acquires satellite timing reference, it will automatically resync to the satellite time reference.

During such outages the GPSPCI will continue to generate time information referenced to the last available satellite timing information. This mode is referred to as freewheeling. When the unit first acquires satellite time, it calibrates an internal clock against the incoming atomic time. During freewheeling the time information will be referenced to this clock and will typically be accurate to within a few milliseconds over a 24 hour period (if the power is not disconnected). As is covered in other areas of this instruction book, the freewheeling status is encoded/decoded by the McrSync software supplied by Masterclock and the operator is given the option of synchronizing to the time information during the freewheeling state.

The transition to and from freewheeling mode is seamless - it does not interrupt time information output.

FREEWHEELING/NON LOCKED LED INDICATION
During a freewheeling period the card LED will be off.

HARDWARE – OPERATING ENVIRONMENT

The GPSPCI is not water or moisture proof. Treat it as you would any other delicate electronic device and do not expose it to water, excessive heat or physical abuse.

SAMPLE WINDOWS APPLICATIONS & BUS PROTOCOL

Included with the GPSPCI (MCRPCI) drivers for Windows, are sample Windows GUI applications and source code in Visual Basic and Visual C++. These items are provided as-is to our end users or to developers. Upon running the MCRSETUP.EXE file that is included with the drivers is run, the sample application and source code is located in the C:\Program Files\Masterclock\MCR directory.

A screen shot of the Visual Basic GUI application is shown below.
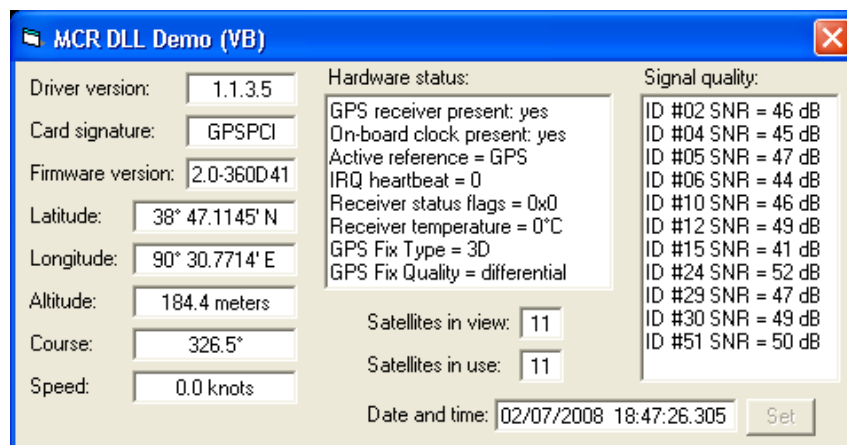
Software application developers, may refer to the MCRPC-GPS ISA/PCI Bus Interface Protocol Version 1.1.0 which is available for download from the support area of our website. http://www.masterclock.com/data_files/mcrpc-gps-card-protocolV110.pdf

DB-9 CONNECTIONS

Pin 1 - Pulse Out
TTL-level 100ms active low pulse generated once per second by the GPS receiver. The negative-going edge of the pulse is aligned with UTC (Greenwich Mean Time) when the receiver has a 3-dimensional GPS satellite fix. This pulse is not available when the GPSPCI is first powered on. The pulse may become unavailable if the receiver loses GPS satellite fix for an extended period of time. Accuracy of this pulse (when synchronized to GPS satellite) is nominally +/- 1μs.

Pin 2 – NC
No connect.

Pin 3 – NMEA
NMEA Oututput , (RS-232 transmit signal from GPS)

Pin 4 - NC
No connect.

Pin 5 - Ground
Connect this pin to the ground of any host receiving NMEa information from the GPSPCI via RS-232.

Pin 6, 7, 8 and 9- NC
No connect.

RS-232 (NMEA MONITORING PORT)

- The GPSPCI provides a monitoring port with NMEA 0183 output messages broadcast from the GPS receiver available once per second, as a RS232 Level on Pin 3 of the DB9 connector. Pin 2 is not connected. Pin 5 is the signal reference/ground.

- Standard NMEA 0183 broadcast messages include :
  - $GPRMC
  - $GPGGA
  - $GPGSV

- Additional Proprietary Garmin GPS NMEA messages are included such as
  - $PGRMF

- The monitoring port requires a null modem RS232 cable along with the following communication port settings:
  > Bits per second: 9600
  > Data bits: 8
  > Parity: None
  > Stop bits: 1
  > Flow control: None

- This function allows external devices connected via the DB9 connector to operate in a listen only mode to broadcast NMEA messages from the GPS receiver.

- This monitor function is always enabled at 9600 Baud
  (Note: most GPS receivers support a native baud rate of 4800).

- Monitoring may be done using a simple terminal monitor application such as Windows *Hyperterminal* or by writing a custom serial port monitoring application. See *Hyperterminal* sample below.

```
Garmin GPS15L output capture 020708 15_36 utc time.TXT - Notepad
File  Edit  Format  View  Help
$GPRMC,153602,A,3847.1142,N,09030.7711,W,000.0,326.5,070208,000.1,W*7F
$GPGGA,153602,3847.1142,N,09030.7711,W,2,10,0.8,177.8,M,-32.6,M,,*7E
$GPGSV,3,3,11,28,16,146,41,48,27,236,47,51,42,206,51*4D
$PGRMF,441,401776,070208,153602,14,3847.1142,N,09030.7711,W,A,2,0,327,2,1*00
$GPRMC,153603,A,3847.1142,N,09030.7711,W,000.0,326.5,070208,000.1,W*7E
$GPGGA,153603,3847.1142,N,09030.7711,W,2,10,0.8,177.7,M,-32.6,M,,*70
$GPGSV,3,1,11,02,57,242,51,04,80,028,49,05,15,317,42,09,23,262,48*70
$PGRMF,441,401777,070208,153603,14,3847.1142,N,09030.7711,W,A,2,0,327,2,1*00
$GPRMC,153604,A,3847.1142,N,09030.7711,W,000.0,326.5,070208,000.1,W*79
$GPGGA,153604,3847.1142,N,09030.7711,W,2,10,0.8,177.6,M,-32.6,M,,*76
$GPGSV,3,2,11,10,01,189,00,12,30,315,45,17,42,079,46,20,13,040,42*70
$PGRMF,441,401778,070208,153604,14,3847.1142,N,09030.7711,W,A,2,0,327,2,1*08
$GPRMC,153605,A,3847.1142,N,09030.7711,W,000.0,326.5,070208,000.1,W*78
$GPGGA,153605,3847.1142,N,09030.7711,W,2,10,0.8,177.5,M,-32.6,M,,*74
$GPGSV,3,3,11,28,16,146,41,48,27,236,47,51,42,206,51*4D
$PGRMF,441,401779,070208,153605,14,3847.1142,N,09030.7711,W,A,2,0,327,2,1*08
$GPRMC,153606,A,3847.1142,N,09030.7711,W,000.0,326.5,070208,000.1,W*7B
$GPGGA,153606,3847.1142,N,09030.7711,W,2,10,0.8,177.4,M,-32.6,M,,*76
$GPGSV,3,1,11,02,57,242,51,04,80,028,49,05,15,317,42,09,23,262,48*70
$PGRMF,441,401780,070208,153606,14,3847.1142,N,09030.7711,W,A,2,0,327,2,1*0D
$GPRMC,153607,A,3847.1142,N,09030.7711,W,000.0,326.5,070208,000.1,W*7A
$GPGGA,153607,3847.1142,N,09030.7711,W,2,10,0.8,177.3,M,-32.6,M,,*70
$GPGSV,3,2,11,10,02,189,00,12,30,315,45,17,42,079,46,20,13,040,42*73
$PGRMF,441,401781,070208,153607,14,3847.1142,N,09030.7711,W,A,2,0,327,2,1*0D
$GPRMC,153608,A,3847.1142,N,09030.7711,W,000.0,326.5,070208,000.1,W*75
$GPGGA,153608,3847.1142,N,09030.7711,W,2,10,0.8,177.2,M,-32.6,M,,*7E
```

- In addition, the GPS receiver PPS (pulse per second) is available on pin 1 of the DB9 for synchronizing the data.

- *Note: this version of the PCB, V1.2, no longer supports full RS232 communications, or the GPSPCI RS232 protocol specification. Only native NMEA output messages from the GPS receiver are available. GPS module configuration can no longer be performed via the RS232 interface*.

PRE-AMPLIFIED ANTENNA

The GPSPCI requires a pre-amplified antenna. It provides 5 VDC via the center pin of the coaxial for remote power. ***Warning: Attaching a passive (non pre-amplified) antenna to the GPSPCI could destroy the GPS receiver module. This is a major repair cost, which is not covered by warranty.***

The unit is tested and shipped with the appropriate cable for the antenna that was ordered. Should you require a longer antenna cable we recommend that you contact Masterclock so that a properly matched cable and antenna can be supplied.

Although changing the GPS antenna or coaxial cable is not technically difficult, these changes are strictly the usre's responsibility. We neither warrant nor support operation with any hardware not installed or supplied by us.

ANTENNA COAXIAL CABLE

The coaxial cable should not be crushed, crimped or bent at a sharp angle nor should it be strained by pulling. Any damage to the cable could result in the GPSPCI not functioning properly. If the cable is to be coiled for storage, the coil diameter should be at least 6".
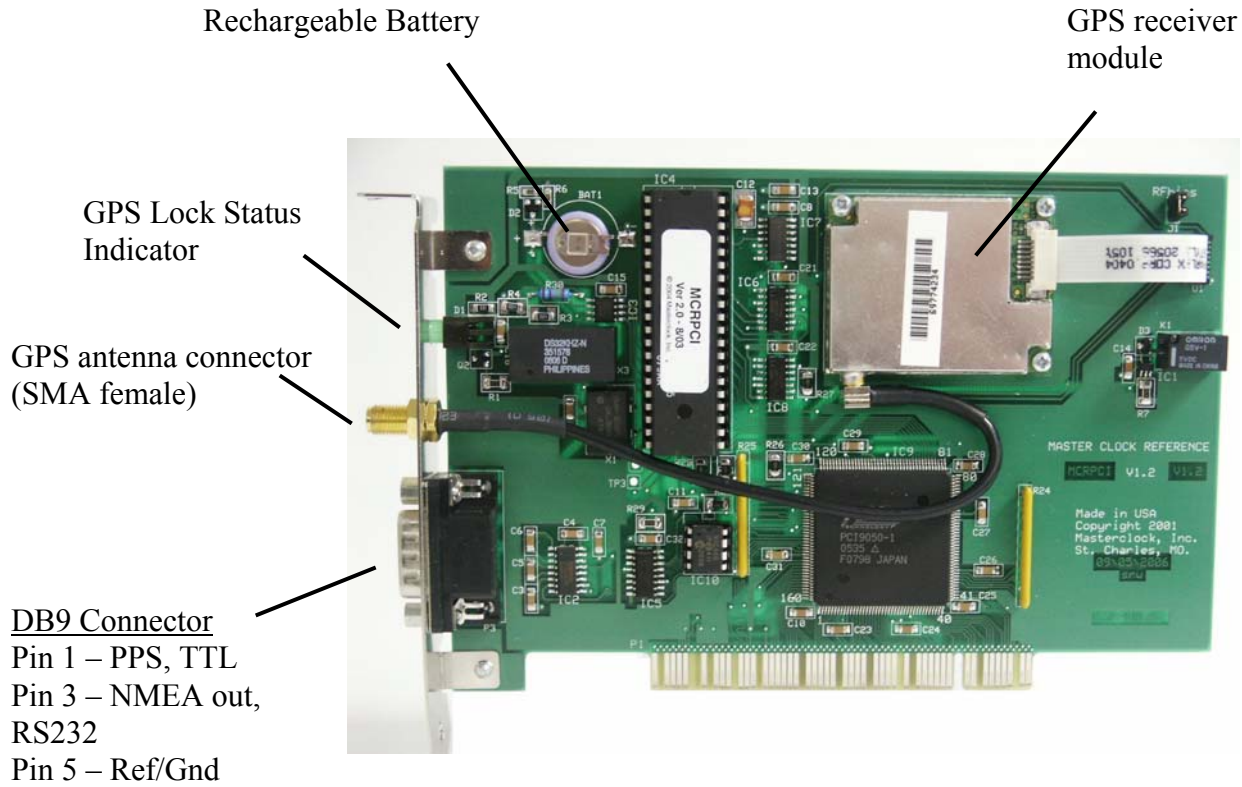
PROBLEMS – TROUBLE SHOOTING

All GPSPCI units are checked for proper operation before shipment. Unless physical damage is found, the unit has been proven to be functional at the factory.

Please remember for an initial startup at a new location the unit could take up to 30 minutes. After the unit has acquired satellites at the new location, the startup time is greatly reduced to anywhere from a few seconds to several minutes.

If the antenna (and coaxial cable) has not been damaged and has an unobstructed view of the sky, the power connector is properly installed and the front panel LED follows the startup sequence described earlier (on, off & then on), the unit is working.

If you continue to have problems even after the above precautions have been noted please contact the factory.

PC BOARD LAYOUT

Rechargeable Battery

GPS receiver module

GPS Lock Status Indicator

GPS antenna connector (SMA female)

<u>DB9 Connector</u>
Pin 1 – PPS, TTL
Pin 3 – NMEA out, RS232
Pin 5 – Ref/Gnd

GPSPCI V1.2

<u>SPECIFICATIONS</u>

<u>TIMING CHARACTERISTICS</u>
     Reference: ....UTC/GMT (default)
     Date
     Short term accuracy ....± 10 µs
     Long term stability...........same as GPS atomic clock

<u>POWER SUPPLY REQUIREMENTS</u>
     Contains its own CPU and requires only DC power from the PC

<u>PHYSICAL</u>
     GPSPCI-PCI ....1/3 slot AT/PCI card, +5VDC

<u>OPERATING TEMPERATURE</u>
     Temperature ....0 to +70 °C

<u>PRE-AMPLIFIED ANTENNA</u>

     Frequency.........................1575 MHz ± 10 MHz
     Polarization ....Right Hand Circular
     Impedance ....50 Ω
     Weight..............................8.3 oz. (235 g)
     Voltage.............................3 -5 VDC
     Power Consumption.........0.24W (@ 20 mA)
     Gain..................................26 dB Standard
     Temperature ....-40 to +70°C
     Connector........................SMA female

<u>COAXIAL CABLE</u>
     Type   51 Ω low loss - RG-58A/U (Belden 8219 or equivalent)
                           SMA-male connectors up to 75'/23m
                           51 Ω low loss – Belden 9913 or equivalent up to 500'/152m

<u>OPTIONS</u>

SYNC-NTP Software   NTP Time Server Software for use with
                                  GPSPCI, MCRPCI, and TCR500-PCI PC cards.

ANTENNA OPTIONS   See website for details www.masterclock.com

LIMITED WARRANTY

This Masterclock Inc. (hereinafter Masterclock) product warranty extends to the original purchaser.

Masterclock warrants the GPSPCI against defects in materials and workmanship for a period of five years from date of sale. If Masterclock receives notice of such defects during the warranty period, Masterclock will, at its option, either repair or replace products that prove to be defective.

Should Masterclock be unable to repair or replace the product within a reasonable amount of time, the customer's alternate remedy shall be a refund of the purchase price upon return of the product to Masterclock. This warranty gives the customer specific legal rights. Other rights, which vary from state to state or province to province, may be available.

EXCLUSIONS

The above warranty shall not apply to defects resulting from improper or inadequate maintenance by the customer, customer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product or improper site preparation and maintenance (if applicable).

WARRANTY LIMITATIONS

MASTERCLOCK MAKES NO OTHER WARRANTY, EITHER EXPRESSED OR IMPLIED, WITH RESPECT TO THIS PRODUCT. MASTERCLOCK SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In any state or province which does not allow the foregoing disclaimer, any implied warranty of merchantability or fitness for a particular purpose imposed by law in those states or provinces is limited to the one-year duration of the written warranty.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE THE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT SHALL MASTERCLOCK BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

In any state or province that does not allow the foregoing exclusion or limitation of incidental or consequential damages, the customer may have other remedies.

HARDWARE SERVICE

You may return your GPSPCI to Masterclock for repair service. Please contact the factory for return authorization before returning the unit.